I claim:

Sub C7

1. A laser system comprising a laser diode with low dimensional quantum structures for emitting light over a wide range of wavelengths, a wavelength-selective element for selecting a wavelength of interest emitted by said laser diode, and an external cavity resonant at a wavelength selected by said wavelength-selective element so that the system generates laser light at said selected wavelength.

sub E1

2. The laser system of claim 1, wherein said low dimensional quantum structures are zero-dimensional or quasi-zero-dimensional (quantum dot) structures.

3. The laser system of claim 1, wherein said low dimensional quantum structures are one-dimensional (quantum wire) structures.

4. The laser system of claim 3, wherein said one-dimensional or quasi-one-dimensional structures are obtained with coupled zero-dimensional structures.

Sub C8

5. The laser system of claim 1, wherein the low-dimensional structures are produced using self-assembly growth methods.

sub E1

6. The laser system of claim 5, further comprising a wetting layer underneath said low dimensional structures such that one or more low-dimensional levels are confined below a barrier energy with one two-dimensional subband for the said wetting layer confined below the barrier energy but above the levels of the low dimensional structures.

7. The laser system of claim 6, wherein a part or for the whole spectral region comprised between the emission of the said wetting layer and the emission of the lowest energy low-dimensional level is tunable for lasing by selecting a parameter selected from the group consisting of: parameters which control the level of saturation or the optical gain.

8. The laser system of claim 7, wherein said laser diode further comprises an electron emitting layer, a hole emitting layer, a series of quantum dot layers in an active region disposed between said electron and hole emitting layers, barrier layers separating each quantum dot layer, and wherein intermediate layers between the said active region and the said electron and hole emitting layers are provided to tailor the optical and electrical properties of the low dimensionality laser diode to specific requirements.

9. The laser system of claim 8, wherein said layers forming the laser diode consist mainly of gallium, indium, aluminum, arsenic, nitrogen, and phosphorus.

10. The laser system of claim 8, wherein said layers forming the laser diode consist essentially of $Al_{x3(1-x2)}Ga_{(1-x3)(1-x2)}In_{x2}As_{1-x1}P_{x1}$ for the electron and hole emitting layers, $Al_{x6(1-x5)}Ga_{(1-x6)(1-x5)}In_{x5}As_{1-x4}P_{x4}$ for the active region, and $Al_{x9(1-x8)}Ga_{(1-x9)(1-x8)}In_{x8}As_{1-x7}P_{x7}$ for the barrier layers.

11. The laser system of claim 10, wherein the layers are grown on a GaAs substrate, and where x1 and x2 equal about 0, x3 equals between 0.3 to 0.8; x4 and x6 equal about 0, x5 equals between 0.3 and 1; x9 equals between 0 to 0.3, and x7 and x8 equals about 0.

12. The laser system of claim 10, wherein the layers are grown on GaAs substrates, and where x1 and x2 equal about 0, x3 equals between 0.3 to 0.8; x4 equals about 0, x6 equals about 1, x5 equals between 0.4 and 1; x9 equals between 0.1 to 0.4, and x7 and x8 equal about 0.

13. The laser system of claim 10, wherein the layers are grown on GaAs substrates, where x3 equals about 0, x1 equals about 1, and x2 is such that this alloy is close to being lattice-matched to GaAs, x4 and x6 equal about 0, x5 equals between 0.3 and 1; x7, x8, and x9 equal about 0.

14. The laser system of claim 10, wherein the layers are grown on GaAs substrates, where x3 equals about 0, x1 equals about 1, and x2 is such that this alloy is close to being lattice-matched to GaAs, x4 and x5 equal about 1, x6 equals about 0; x9 equal about 0, and x7 and x8 are such that this alloy is close to being lattice-matched to GaAs.

15. The laser system of claim 10, wherein the layers are grown on InP substrates, where x1 equals about 0, x2 equals about 0.52, x3 equals about 1; x4 and x6 equal about 0, x5 equals between 0.6 and 1; x9 equals between 0 to 0.5, x7 equals about 0, and x8 equal about 0.52.

16. The laser system of claim 10, wherein the layers are grown on InP substrates, where x1 equals about 0, x2 equals about 0.52, x3 equals about 1; x4 and x6 equal about 0, x5 equals between 0.6 and 1; x7, x8 and x9 are adjusted to form a quaternary alloy close to lattice-matched on InP with the desired bandgap.

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17. The laser system of claim 10, where said wavelength-selective element used to tune the laser output consists of an element selected from the group consisting of: a diffraction grating, a prism, a birefringent element, an etalon, and a dispersive element.

18. The laser system of claim 17, wherein said external cavity is defined between a pair of mirrors with appropriate reflectance, and said wavelength-selective element acts as an output-coupler of light ~~from said laser diode into said external cavity.~~ a

19. The laser system of claim 18, wherein one or more of said mirrors is selected from a group consisting of: a facet of said laser diode, or the wavelength-selective element which can also act as an output coupler.

20. The laser system of claim 18, further comprising optical and spatial filters in said external cavity.

21. A method of producing low-dimensionality laser diodes having an adjustable gain spectrum based on a quantum material with low-dimensional density-of-states which relies on self-assembled quantum dots obtained by spontaneous island formation during epitaxy of highly strained semiconductors, comprising:

a) selecting a barrier material and a quantum material such that the degree of lattice-mismatch dictates a critical thickness required to obtain spontaneous island formation, and the bandgap difference determines a possible number of confined states in conjunction with the energy spectrum of the low-dimensional states;

b) growing some thickness of said barrier material in an active region between an electron emitting layer and a hole emitting layer on a substrate, said electron and hole emitting layers having a lattice constant close to that of said substrate;

c) depositing, at a specified growth rate, said quantum material at a temperature which will produce quantum dots ~~having the~~ appropriate size and shape to obtain said low-dimensionality density-of-states;

d) ceasing the growth of said quantum material after the desired number of quantum dots per unit area is reached;

e) waiting a specified amount of time to allow for the self-assembling growth to form the quantum dots in shapes and sizes which will give said low-dimensionality density-of-states; and

f) growing some thickness of said barrier material to cover the quantum dots and

return to a planar growth front at a substrate temperature which may be varied during the growth and which will optimize the quality of the quantum dots.

22. A method as claimed in claim 21, wherein steps *b* to *f* are repeated necessary to obtain several layers of quantum entities.

23. A method as claimed in claim 22, wherein said quantum dots are coupled to provide one dimensionality density-of-states.

24 ~~25~~. A method of generating tunable laser light over broad spectral ranges from a laser diode, comprising:

using electrical power to generate laser emission from a low-dimensionality laser diode which has been designed with an active region having semiconductor quantum entities with low-dimensionality energy levels as established by the size and composition of the quantum entities and the height of the confining potential of the barriers;

placing the said low-dimensionality laser diode in an external-cavity with a wavelength-selective element; and

tuning said wavelength-selective element to obtain the desired output wavelength within the tunable range of the laser.

25 ~~27~~. A method as claimed in claim 26, wherein said wavelength-selective element is tuned mechanically.

26 ~~28~~. A method as claimed in claim 25 ~~27~~, wherein said wavelength-selective element is tuned with the aid of automated electro-optical actuating devices.

27 ~~29~~. A method as claimed in claim 25 ~~27~~, wherein the cavity parameters are also tuned.